Patent Application of

Charles D. Murphy

for

TITLE OF INVENTION

SHARED MULTIPLICATION IN SIGNAL PROCESSING TRANSFORMS

CROSS-REFERENCE TO RELATED APPLICATIONS

The invention is related to NON-CONSTANT REDUCED-COMPLEXITY MULTIPLICATION IN SIGNAL PROCESSING TRANSFORMS submitted as a separate application by Charles D. Murphy. This invention is related to MULTIPLE NUMBER REPRESENTATIONS FOR MULTIPLICATION COMPLEXITY REDUCTION IN SIGNAL PROCESSING TRANSFORMS submitted as a separate application by Charles D. Murphy. This invention is related to DESIGNING SIGNAL PROCESSING TRANSFORMS WITH NON-

CONSTANT REDUCED-COMPLEXITY AND SHARED MULTIPLICATION submitted as a separate application by Charles D. Murphy. As of the mailing date of the present application, the first related application has been submitted. As of the mailing date of the present application, the second and third related applications have not yet been submitted.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable

REFERENCE TO A MICROFICHE APPENDIX

Not applicable

BACKGROUND – FIELD OF INVENTION

The invention relates to number transforms used in signal processing, specifically to sharing computation when calculating products for transforms that use sums of products.

BACKGROUND – DESCRIPTION OF PRIOR ART

Signal processing involves manipulation of one or more input signals in order to produce one or more output signals. In digital signal processing, the signals are represented by numbers. The numbers have finite-precision representations in particular formats such as binary twos complement, signed integer, unsigned integer, and floating point, among others.

Arithmetic operations are basic tools of digital signal processing. Two of the most important arithmetic operations are multiplication and addition. While these two operations can be used to compute a wide variety of mathematical functions, a very important class of signal processing transforms consists of transforms that compute sums of products. Important examples of such

transforms are discrete Fourier transforms, discrete cosine transforms, discrete sine transforms, and corresponding inverse transforms for each. Typically, these transforms accept a set of inputs, multiply the inputs by sets of weights, and add the resulting products to produce a set of outputs. In these transforms, addition and multiplication operations are used repeatedly, and sometimes exclusively.

Computational complexity is an important issue in practical applications of signal processing transforms. For signal processing transforms that make extensive use of multiplication and addition operations, the computational complexity may be measured by the total number of multiplication operations, the total number of addition operations, or both. Ultimately, each arithmetic operation has a cost measured in terms of chip space, power consumption, processor cycles, or some other resource.

In some important technologies, such as application-specific integrated circuits, field-programmable gate arrays, and general purpose microprocessors, a multiplication operation may be much more expensive than an addition operation, so that the multiplication count dominates the computational complexity. It is particularly desirable when using such technologies to reduce the number of multiplication operations, to reduce the cost of multiplication operations, or to reduce both.

A general multiplier is a circuit or sequence of operations that is able to compute the product of two numbers. It is possible that the two numbers take on any value permitted by their respective finite-precision numeric formats. Since it can accept any pair of input numbers, a general multiplier is very flexible and can be re-used within an application or in different applications. However, it may be very costly to implement.

A constant multiplier is a circuit or sequence of operations that is able to multiply a number by a constant. The number may take on any value allowed by